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Fig. 6. *Lamprocanthia crassicornis*, egg in situ between the leaves of moss.

Fig. 7. *Salda anthracina* egg. Camera lucida drawing. (Same scale as Figs. 6 and 11.)

Fig. 8. *Hebrus*. Egg in situ between the leaf and stem of a close-growing moss.

Fig. 9. *Lamprocanthia crassicornis*, ventral view of abdomen of male.

Fig. 10. A clump of sedges showing the eggs of *C. crassicornis* in situ.

Fig. 11. *L. crassicornis* egg. Compare with Fig. 7.

Fig. 12. *L. crassicornis*, ventral view of abdomen of female.

THE EUROPEAN MOLE CRICKET, *GRYLLOTALPA* *GRYLLOTALPA* L., AN INTRODUCED INSECT PEST.

BY HARRY B. WEISS AND EDGAR L. DICKERSON,¹

NEW BRUNSWICK, N. J.

The occurrence of the European Mole Cricket in this country has already been recorded (Jour. Econ. Ent., Vol. VIII, p. 500) but as the insect still maintains its existence in the place where it was first observed and as it may be introduced into other localities, it seems worth while to give a brief account of its habits and development. As previously noted the insect was first observed in this country in a nursery at Rutherford, N. J., where a large number of plants are yearly imported from Europe. "This infestation, which is undoubtedly of several years' duration, extends over several acres planted to herbaceous and ornamental stock, a considerable portion of which is used for show purposes only. The soil is rather light and porous and contains a variety of shrubs, shade trees, etc., such as one would naturally find in a nursery. No preference is shown by the cricket for any particular plant, its zig-zag burrows being found in different parts of the area irrespective of the kinds of plants growing there. The insects have been numerous enough for the nursery to detail several men at certain periods to hunt them out and destroy as many as possible every few days."

¹ The arrangement of the authors' names has no significance and indicates neither seniority nor precedence.

In regard to its occurrence in the Old World, Step states that it is plentiful in central and southern Europe and extends through Egypt and Western Asia to the Himalayas. In some localities, at least, it is abundant enough to cause more or less injury and accounts of its life history and habits may be found in various European publications. A few of these references are noted at the end of this paper and it is from these and from our observations at Rutherford that material for this account has been obtained.

The adult hibernates in horse manure or other warm places and becomes active in March. Mating occurs above ground in May and shortly afterward oviposition takes place. For this purpose, the female burrows into the ground and two or three inches below the surface, makes an oval chamber about the size of a hen's egg. According to Wood, the chamber is placed near the surface so that the eggs may be affected by the sun's heat. In this cavity eggs are laid from time to time, the total numbering from 100 to 400. The individual egg measures 2.5 mm. in length, is of an oval shape and dirty, grayish yellow in color. At Rutherford, in mid July, both eggs and young nymphs were collected, in some cases from the same nest. In about thirty days the young appear and remain in or near the nest under the supervision and protection of the female until after the first molt, according to some authors and until after the second molt, according to others. Step states that the female has to protect the young from the male. According to Van Den Broek and Schenk, the third molt occurs near winter and in April of the next year, the fourth molt takes place and wing pads appear. The fifth and last molt occurs about a month later and soon afterward mating takes place. Some authors believe that four years are required for the completion of the insect's development.

In both sexes the wings are folded close against the body; the elytra or fore wings are comparatively broad and short and reach about half the length of the abdomen, while the under wings compactly folded extend posteriorly between the anal cerci. Figuiet says "they make little use of them (the wings), and it is only at nightfall that the mole cricket is seen to disport himself describing curves of no great height in the air." Wood states that "the flight of the mole cricket consists of a series of dips."

Thus while the insect may be found above ground in flight and at

mating time, it exists for the most part below the surface, burrowing in the soil and is active principally at night. Many times the burrow of the insect is found just below the surface so that the earth is raised above the gallery resembling a miniature mole burrow and by these the presence of the insect may be detected. Many of these surface galleries, extending irregularly through the soil, were noted at Rutherford and one of the workmen who had been acquainted with the insect in Europe stated that they were made by the male. When these were followed, they would frequently be found to extend down into the soil, especially where they came in contact with an obstruction such as a flower pot. In some cases they ended blindly near the surface. The burrow made by the female and connected with the egg chamber was quite different. In this case a channel about one inch below the surface extended in the form of a circle five or six inches in diameter. A burrow led from this somewhat downward and toward the center of the circle and terminated in the egg chamber. Another channel extending outward and downward from the circular one was apparently a place of retreat for the female since it was always in this latter burrow that the female was found whenever the ground above the egg cavity was disturbed and the egg chamber removed from the ground.

These galleries may occur in a variety of soils. Van Den Broek and Schenk state that the insect prefers soils rich in humus and may be found in different parts of Holland, sometimes in clay soil which is not too stiff. Wood says the insects prefer a loose sandy soil, but this does not appear probable for as Figuier suggests "the chamber is scooped out in soil stiff enough to resist the action of rain." An examination of the arrangement and structure of the anterior legs shows how well these insects are fitted for working in the soil. These legs fit closely against the lower outer margins of the thorax and sides of the head, being broadened dorso-ventrally. The outer extremity of the tibia is provided with four well-developed teeth, while the modified tarsus also possesses two tooth-like projections and these are so arranged that they may move over some of the teeth of the tibia forming a shear-like arrangement, which it has been suggested is useful in cutting roots as the insect works its way through the ground. Moreover, an examination of living specimens shows that they can exert considerable pressure outward with the forelegs.

It has further been suggested that the anterior portion of the pronotum which covers the posterior portion of the head like a hood is used in shaping the gallery.

The object of the insect in burrowing through the soil is to obtain food, but there is a difference of opinion as to what it prefers. Some writers state that the normal food is vegetable matter while others assert that it is of an animal nature. Whichever may be the case, the insect is certainly harmful, causing considerable injury to plants. Van Den Broek and Schenk record it as injurious in truck gardens and nurseries, getting into heated frames and seed beds and destroying carrots and other plants, the roots of which it cuts off with its fore legs. Step states that the insect is not entirely vegetarian and probably only very slightly so. He says that while the insect has been accused of eating raw potatoes, it was probably after the insects associated with these vegetables. As indicative of its cannibalistic habits he states that the male has to be kept from the young nymphs and cites the fact that when three male crickets were shipped together with some terrestrial insects and pieces of potato, the terrestrial insects were devoured and two of the mole crickets were injured, while the pieces of potato were untouched. Wood, on the other hand, suggests that the normal food is plant tissue and that much damage is done to root crops where the insect is common. He states, however, that they will eat raw meat and are on occasion cannibals, as the males are quarrelsome and will fight to death, the victor always eating his conquered adversary.

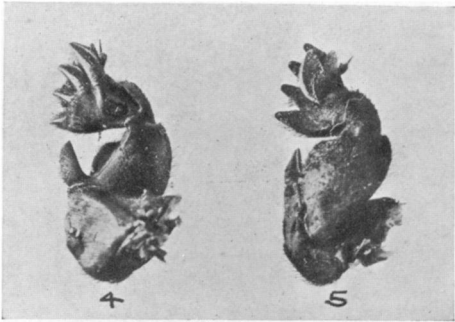
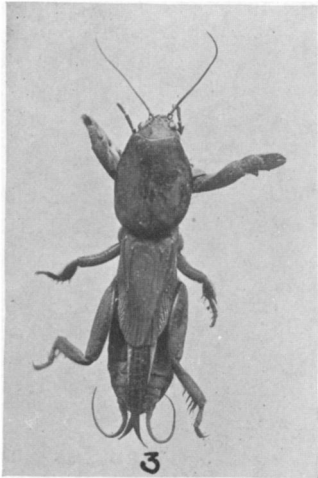
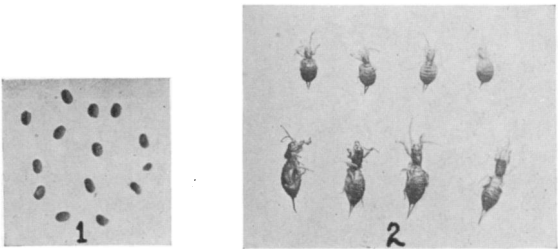
Another investigator states that they are injurious to root crops but may prey upon underground insects and reports that a Mr. Gould "fed a mole cricket for several months upon ants." One Russian investigator found that the mole cricket is useful in destroying the larvæ of *Melolontha* but concludes that the damage done in fields and orchards outweighs the beneficial work. In Russia, the insect has been recorded as injurious in market gardens, orchards and even forests, attacking tomatoes, cabbage, turnips and other vegetables, hops, tobacco, plum and forest trees. In France similarly, the insect is injurious in market gardens and chicory seedlings, onion and lettuce are cited as particularly subject to injury while rice is mentioned as being attacked in Italy.

From these foregoing records, it is very evident that the mole

cricket is a considerable pest in numerous localities and, as one might imagine, a number of remedies or methods of dealing with it have been suggested. Among these, the following may be noted. First, using poisoned baits such as corn treated with arsenic, or cornstarch, water and phosphorus, these to be put in burrows or scattered on the ground before seeding time. Second, by injecting some substance into the burrows such as naphtha, petroleum, a 25 per cent. emulsion of petroleum, soapy water or calcium carbide. In this latter case, the moisture present liberates acetylene gas. Third, trapping the insects by a pot sunk into the soil and covered with a board or by means of holes filled with manure or vessels filled with water placed in the soil at different distances. Fourth, placing material on the surface such as lime at the rate of 16 cwt. to the acre or the use of naphthalene in the ground as it is being tilled. Fifth, by destroying the nests of the insects.

At Rutherford, a workman who was employed in the nursery, and who was engaged part of the time in dealing with this pest, used the following method to destroy the eggs and female. A circular gallery of the female was located by its exit hole, then the circular burrow followed around and with a trowel a cone-shaped mass of earth was removed, including the egg chamber and its contents, which were destroyed. The surface of the cone-shaped depression thus left was smoothed down and the gallery running from it, into which the female retreated, located and its opening cleaned out. Then a spoonful of kerosene was poured into the depression and, following this, enough water to fill up the depression and gallery. The kerosene rising to the surface flowed with the water into the gallery in which the female was hiding and forced her to emerge.

It might be added that the mole cricket is capable of producing a sound which is said to be not so shrill as that of the domestic cricket. Figuier states, "from the month of April the males betake themselves to the entrance of their burrows and make their cries of appeal. Their notes are slow, vibrating and monotonous and repeated a long time without interruption and somewhat resembling the cry of the owl or goatsucker." Step describes it as a dull sound like "the churring of the goatsucker among birds." In consequence of this sound, according to Wood, it has received the following



Gryllotalpa.

popular names: churr-worm, jarr-worm, eve-churr, croaker. It is also known as the earth crab on account of its structure.

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EXPLANATION OF PLATE II.

- Fig. 1. Eggs.
Fig. 2. Young nymphs.
Fig. 3. Adult *Gryllotalpa gryllotalpa*.
Fig. 4. Inner view of fore-leg (enlarged).
Fig. 5. Outer view of fore-leg (enlarged).
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ANTS COLLECTED IN BRITISH GUIANA BY MR. C. WILLIAM BEEBE.

BY WILLIAM MORTON WHEELER,
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Mr. C. William Beebe of the New York Zoölogical Park recently sent me for identification a series of ants from British Guiana. The specimens had been collected with an umbrella Sept. 15 to 20, 1917, near the Penal Settlements in the Bartica District from an area of only twenty square feet of bushes in a clearing. There are 156 specimens representing 42 distinct forms. Most of these are well-known neotropical species commonly found running over foliage, but fifteen of them (indicated by asterisks in the list) have not before been recorded from British Guiana and two of them are new to science.